

INDOOR AIR QUALITY REASSESSMENT

**Ralph B. O'Maley Middle School
32 Cherry Street
Gloucester, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
December 2003

Background/Introduction

At the request of the Gloucester School and Health Departments, Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) conducted several assessments of indoor air quality (IAQ). These assessments include the following: a complete IAQ assessment of the entire school in April 2002 (MDPH, 2002a) and an evaluation specific to the gymnasium in June 2002 (MDPH, 2002b). On December 12, 2002, Cory Holmes, Environmental Analyst of BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program returned to the school to evaluate remedial actions conducted to date and identify concerns specific to potential exposure to carbon monoxide (CO) due to heating system repairs. Mr. Holmes was accompanied by Dave Anderson, Facilities Director for the Gloucester School Department.

Although BEHA agreed at the time to conduct a reassessment with respect to concerns over CO related to heating system repairs, staff made it clear that an MDPH report of findings would not be issued until written documentation of remedial actions taken by local officials had been submitted. The Gloucester School Department (GSD) did provide BEHA with a written report in late August 2003 detailing all the steps that had been taken prior to BEHA's December 2002 assessment (Appendix I).

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

This school has a student population of approximately 900 in grades 6-8, as well as a staff of approximately 120. Tests were taken during normal operations at the school and results appear in Table 1. No levels of carbon monoxide above background levels were measured in the building during the assessment.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million of air (ppm) in twenty-four of thirty-four areas surveyed, indicating adequate ventilation in most areas of the school during the reassessment. In several areas with elevated carbon dioxide levels, airflow was minimal due to occupant deactivation of unit ventilators (univents). Another area where carbon dioxide levels were consistently elevated was on the second floor in classrooms 202-205 and 219-220. The univent in classroom 202 was cycling “off” during the assessment, preventing a constant source of airflow. Mr. Anderson made a note of these rooms for further investigation. Although overall conditions have improved, obstructions to airflow, such as items stored on or in front of univent returns, were still seen in a number of classrooms. As stated in the previous BEHA reports, in order for univents to provide fresh air as designed, intakes/returns must remain free of obstructions. Importantly, these units must remain “on” and be allowed to operate while rooms are occupied.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing

adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide see [Appendix II](#).

Temperature readings ranged from 65° to 79° F, which were outside the BEHA recommended guidelines in some areas. The BEHA recommends that indoor air temperatures be maintained in a range of 70° to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It is also difficult to control temperature without the mechanical ventilation system functioning properly (e.g. univents deactivated, cycling on and off).

Relative humidity measured in the building was below the BEHA recommended comfort range in all areas sampled, with the exception of the nurse's office. Relative humidity measurements ranged from 29 to 42 percent. The BEHA recommends that indoor air relative humidity is comfortable in a range of 40 to 60 percent. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a common problem during the heating season in the northeast part of the United States.

Other Concerns

A petroleum odor was detected in the main corridor near the elevator shaft. School maintenance personnel explained that the motor at the bottom of the shaft had a hydraulic fluid leak, due to a faulty part. A catch basin containing hydraulic fluid was observed beneath the motor. Hydraulic fluid contains volatile organic compounds (VOCs), which can be irritating to the eyes, nose and throat. Hydraulic fluid odors can be distributed to other floors via the elevator. Negative pressure placed on the shaft by the piston effect can draw air in the elevator shaft, providing a means for odors to penetrate into occupied areas. Also noted in the elevator shaft was a deactivated local exhaust fan. To help prevent odors from migrating into the hallway, Mr. Anderson reactivated this thermostat-controlled fan.

A strong odor was detected in room 204. The source was identified as a time-released, plug-in air freshener. Air fresheners contain chemicals that can be irritating to certain sensitive individuals. In addition, air fresheners do not remove materials causing odors, but rather mask odors, which may be present in the area.

In an effort to reduce noise from sliding chairs, tennis balls have been sliced open and placed on chair legs. Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and off-gas VOCs. Tennis balls are

made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g. spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as [Appendix III](#) (NIOSH, 1998).

Conclusions/Recommendations

GSD officials, working in conjunction with private contractors, faculty members and school maintenance staff, have significantly improved indoor environmental conditions in the building by implementing BEHA's previous recommendations. In view of the findings at the time of the reassessment, the following additional recommendations are made to further improve indoor air quality:

1. Continue efforts to educate staff concerning the importance of operating the ventilation system appropriately and keeping ventilation vents unobstructed.
2. Coordinate efforts between GSD maintenance staff and building occupants for reporting and repairing faulty HVAC system components to improve airflow and comfort.
3. Refrain from using strong-scented materials (e.g. air fresheners).
4. Consider discontinuing the use of tennis balls on furniture.
5. Continue to operate local exhaust fan to help prevent odor migration into occupied areas until repairs can be made to the elevator hydraulic system.
6. In order to maintain a good indoor air quality environment on the building, consideration should be given to adopting the US EPA document, "Tools for Schools". This document can be downloaded from the Internet at <http://www.epa.gov/iaq/schools/index.html>.

References

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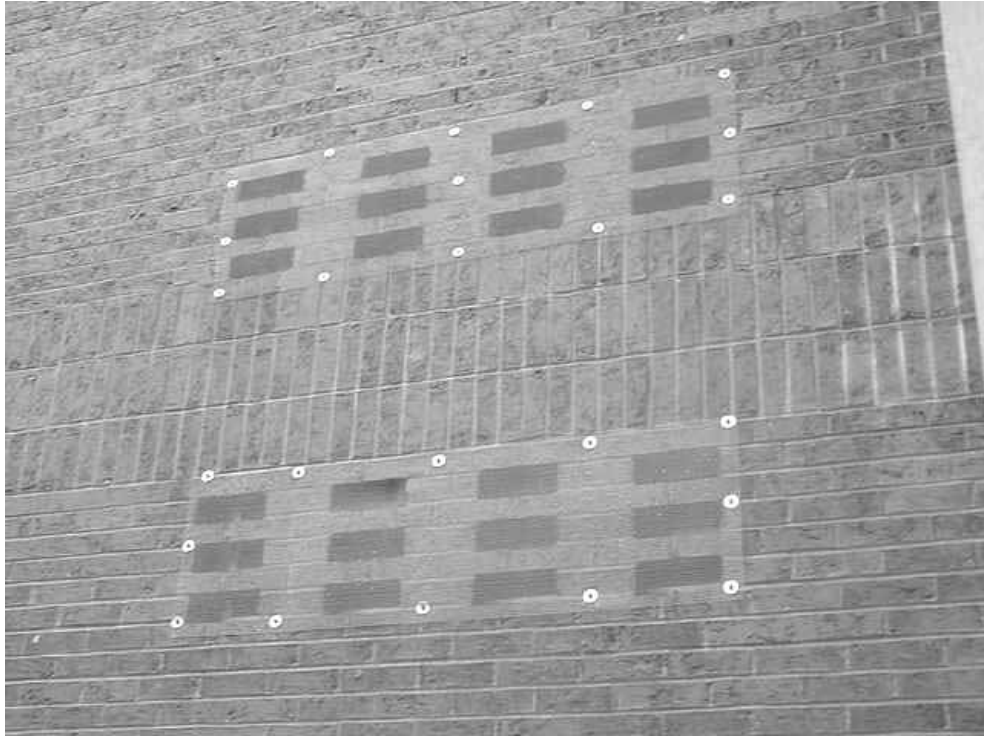
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Picture A-1



Bird Screens Installed over Univent Air Intakes

Picture A-2



Unsealed Expansion Joint

Picture A-3



Univent Return Vent Covered with Fabric Preventing Airflow

Picture A-4



Exhaust Vent Blocked by Waste Basket

Picture A-5



Commercial Cleaning Products on open Shelf in Classroom

Picture A-6



Accumulated Chalk Dust in Classroom

Picture A-7



Roofing Material Stains in 315 Prep-Room

TABLE 1

Indoor Air Test Results – O'Malley Middle School, Gloucester, MA

December 12, 2002

Location	Carbon	Carbon	Temp	Relative	Occupants	Windows	Ventilation		Remarks
	Dioxide *ppm	Monoxide *ppm	°F	Humidity %	in Room	Openable	Intake	Exhaust	
(Outside) Background	374	0-1	44	54					Moderate to heavy rain fall
Nurses Office	914	0	65	42	7	Y	Y	Y	Window open
Room 211	642	0	70	32	20	N	Y	Y	Temperature complaints – cold
Room 209	689	0	72	31	24	N	Y	Y	MT
Room 9	478	0	68	30	10	N	Y	Y	Periodic sewer gas odors
Boys Locker Room	539	0	71	31	3	N	Y	Y	MTs
Lower Gym	617	0	71	31	15-20	N	N	N	Complaints of cleaner odors
Custodian Closet	510	0	72	31	0	N	N	Y	5-gal – empty container of cleaner
Ice Rink Corridor		0							Double doors being installed between rink and school
Art Room	604	0	65	32	21	Y	Y	Y	Exterior door open

* ppm = parts per million parts of air
UV = Univent

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred	(1 Story – Red Brick)
	600 - 800 ppm = acceptable	
	> 800 ppm = indicative of ventilation problems	
Temperature -	70 - 78 °F	
Relative Humidity -	40 - 60%	

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Elevator Shaft							N	Y	Hydraulic oil leak, exhaust fan off / reactivated via thermostat
Room 307	908	0	75	31	17	Y	Y	Y	UV – deactivated
Room 302	734	0	74	29	22	Y	Y	Y	Window caulking - loose
Room 303	765	0	71	29	19	Y	Y	Y	6 plants
Room 305	780	0	70	31	1	N	Y	Y	
Supervisors Office 7 th Grade	667	0	73	31	1	N	Y	Y	Heat issues
Room 309	798	0	79	30	20	N	Y	Y	3 CT, dirt/dust accumulation
Room 312	776	0	73	29	21	Y	Y	Y	Door open Window condensation
Room 315	794	0	69	29	0	Y	Y	Y	Occupants gone for lunch Birds, aquarium

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Room 209	650	0	70	32	15	N	Y	Y	
Room 202	852	0	69	33	10	Y	Y	Y	Door open UV deactivated- heat issues
Room 204	910	0	70	34	22	Y	Y	Y	UV return covered w/ paper Plug-in air freshener
Room 205	866	0	72	36	19	Y	Y	Y	
Room 203	1009	0	71	37	16	Y	Y	Y	Window caulking, UV deactivated, reactivated by Mr. Anderson
Room 220	1362	0	77	35	18	Y	Y	Y	
Room 219	1283	0	74	32	20	Y	Y	Y	Plants and tennis balls
Room 126	732	0	72	30	20	Y	Y	Y	
Room 109	904	0	72	31	2	Y	Y	Y	24 occupants gone about 10 min/stuffy

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Room 107	718	0	72	32	1	N	Y	Y	
Room 105	795	0	70	33	1	Y	Y	Y	26 occupants gone 25 min
Room 104	636	0	69	32	1	Y	Y	Y	3 CT 22 occupants gone 30 min
Room 103	1015	0	69	34	2	Y	Y	Y	Door open, cold complaints
Room 111	649	0	71	30	7	N	Y	Y	Plants
Room 120	553	0	70	31	0	Y	Y	Y	
Room 118	791	0	70	34	1	Y	Y	Y	1 MT - exhaust vent water damaged CT
Room 116	620	0	72	33	0	Y	Y	Y	
Room 115	771	0	74	33	0	Y	Y	Y	Strong chemical odors (cleaning product), plug-in air freshener, thermostat problem noted by Mr. Anderson

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Appendix I

Gloucester School Department Actions on MDPH Recommendations

The following is a status report of actions taken on MDPH recommendations (**in bold**). The summary is based on reports from Gloucester School Department (GSD) Officials, school maintenance staff, and documents, as well as photographs and observations made by MDPH-BEHA staff.

Actions on **Short-Term** Recommendations:

1. **Continue to seal the floor drain in the mechanical room during the heating season or ensure water is poured into the drains every other day to maintain the integrity of the traps.**

Action Taken: Floor drains are sealed during the heating season and water is poured into traps regularly.

2. **Seal the condensation drains for AHUs during the heating season. Please note that these drains must be unsealed during the air-conditioning season in order to drain condensation. Failure to remove condensation drain seals can result in water back up into AHUs and the potential for mold growth.**

Action Taken: AHU condensation drains are sealed during the heating season and removed during the cooling season.

3. **Clean interior and exterior of univents completely of bird wastes, in accordance with CDC health and safety practices before-reactivating univents. To prevent further bird roosting, consider installing bird screens to the *outside* of brick openings.**

Action Taken: Univents were cleaned and disinfected. Bird screens were installed over openings to prevent bird roosting (Picture A-1).

- 4. Examine all expansion joint seals on the exterior wall system. Reseal all expansion joints with damaged, missing or eroded sealant.**

Action Taken: Some expansion joints were not resealed during the reassessment (Picture A-2), this activity is reportedly on-going.

- 5. To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy independent of classroom thermostat control.**

Action Taken: Some univents were found deactivated during the reassessment.

- 6. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Operate univents while classrooms are occupied. To increase airflow, set univent controls to “high”. Consider consulting a heating, ventilation and air conditioning (HVAC) engineer concerning the calibration of univent fresh air control dampers school-wide.**

Action Taken: Most of the univents were operating during the assessment. A number of thermostats and controls were replaced to correct heat issues. Maintenance and calibration of univents is on-going.

- 7. Inspect exhaust motors and belts for proper function, repair and replace as necessary.**

Action Taken: A preventative maintenance program has been instituted.

- 8. Remove all blockages from univents and exhaust vents.**

Action Taken: Univents and exhaust vents were still obstructed in some classrooms (Pictures A-3 & A-4).

- 9. Consider having the systems re-balanced every five years by an HVAC engineering firm.**

Action Taken: Balancing of HVAC systems is on-going by GPS staff HVAC engineer.

- 10. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).**

Action Taken: School officials are working with maintenance staff and faculty to reduce clutter and improve cleaning.

- 11. Replace/repair any remaining water-stained ceiling tiles and building materials. Examine the area above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.**

Action Taken: Ceiling tiles are changed and building materials are inspected and cleaned as needed.

- 12. Move plants away from univents in classrooms. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.**

Action Taken: Faculty have been advised to inspect and maintain plants and drip pans.

- 13. Continue with plans to repair/replace window systems.**

Action Taken: Window systems were not yet replaced at the time of the reassessment.

- 14. Clean and maintain aquariums and terrariums to prevent bacterial/mold growth. Remove decaying fish from aquarium in classroom 111.**

Action Taken: Aquariums and terrariums were being properly maintained. Aquariums were removed from classroom 111.

- 15. Seal areas around sinks to prevent water-damage to the interior of cabinets and adjacent wallboard. Inspect wallboard for water-damage and mold/mildew growth, repair/replace**

as necessary. Disinfect areas of microbial growth with an appropriate antimicrobial as needed.

Action Taken: Sinks have reportedly been sealed.

- 16. Remove clog and flush drain in classroom 315. If not in use, seal drains or pour water down regularly to prevent sewer gas back up.**

Action Taken: Drain was unclogged and flushed, water is poured down drains regularly.

- 17. Store cleaning products properly and out of reach of students. Store flammables in a flameproof cabinet.**

Action Taken: Commercial cleaning products continued to be kept in unlocked cabinets in classrooms (Picture A-5).

- 18. Replace missing ceiling tiles, to prevent the egress of dirt, dust and particulate matter into classrooms. Refrain from hanging objects from ceiling tile system.**

Action Taken: Ceiling tiles were replaced and hanging items were removed.

- 19. Have a chemical inventory done in all storage areas and classrooms. Properly store flammable materials in a manner consistent with the local fire code. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Label chemical containers with the chemical name of its contents. Follow proper procedures for storing and securing hazardous materials.**

Action Taken: MSDS sheets for all materials are kept on site, training is provided as needed.

- 20. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.**

Action Taken: Several areas continue to have accumulated items and dust/debris accumulation (Picture A-6)

- 21. Obtain Material Safety Data Sheets (MSDS) for chemicals from manufacturers or suppliers. Maintain these MSDS' and train individuals in the proper use, storage and protective measures for each material in a manner consistent with the Massachusetts Right-To-Know Law, M.G.L. c. 111F (MGL, 1983).**

Action Taken: See Action 19.

- 22. Clean chalkboards and trays regularly to avoid the build-up of excessive chalk dust.**

Action Taken: Several classrooms continue to have accumulated chalk dust (Picture A-6)

- 23. Clean and disinfect walls of the 315 prep room and any other areas coated with dried roofing material.**

Action Taken: Walls were not cleaned of the dried roofing material during the reassessment (Picture A-7).

- 24. Seal boiler room door with weather-stripping material and ensure all utility holes, wall cracks and any other possible pathways are sealed to prevent the egress of boiler room/fuel odors into occupied areas.**

Action Taken: Boiler room door and many utility holes were sealed to prevent odor migration. GSD maintenance staff continue to examine and seal any breaches found.

- 25. Relocate student drop off area or consider posting signs instructing drivers to shut off engines after five minutes as required by Massachusetts General Laws 90:16A. If not feasible, consider installing a timer to deactivate univent in nurse's area prior to student pick up.**

Action Taken: A timer was installed to deactivate univent in nurse's suite.

Actions on **Long-Term** Recommendations:

1. **Examine the seal around each univent fresh air intake louver grille for sealant integrity.**

Reseal each joint to prevent air bypass.

Action Taken: This action has not been acted upon by the GSD at the time of the reassessment.

2. **Seal all pipe holes within univents.**

Action Taken: This action is reportedly on-going.

3. **To prevent water penetration in/around univents consider installing an awning type structure to prevent penetration from wind driven rain.**

Action Taken: This action has not been acted upon by the GSD at the time of the reassessment.

4. **Replace/repair missing/damaged radiator baseboard diffusers throughout the school.**

Action Taken: This action is reportedly on-going.

In addition to the above actions, a number of other activities to improve air quality have been completed. These actions include: repairing the chimney/boiler room exhaust system, installing carbon monoxide monitors near the boiler room and installing doors to act as a barrier between the ice rink and the school. GSD officials also reported that a health and safety committee has been created. The committee consists of members of the custodial staff, school department personnel, faculty and school administrators.